Drug diffusion in eutectogels: an NMR study

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Deep eutectic solvents (DES) are a class of eutectic mixtures made of two or more components, with an eutectic point far below than the melting temperature of the pure components. This decrease of the melting point in DES is due to the strong hydrogen bonding interactions between its different constituents. To date, DESs have found applications in a wide range of fields, including glass and ceramic industries, energy storage devices, and pharmaceutical formulations. In the pharmaceutical field, eutectic mixtures have long been utilized to improve drug bioavailability and permeation across human epidermal membranes.[1]

A further step in the use of DESs as drug delivery systems is related to the possibility to develop gel-based DESs "eutectogels" able to deliver the loaded drugs in a controlled way.[2] Form this starting point, we aim to synthetize and characterize supramolecular gels based on DESs and dissolve some active pharmaceutical ingredients in them at different concentrations. The final goal is to study the properties of these systems from a microscopic point of view, mainly exploiting ^{1}H High-Resolution Magic Angle Spinning (HR-MAS) NMR technique to investigate drug dynamics in eutectogels. The gels prepared are based on nonionic type V DESs consisting of thymol as hydrogen bond donor and menthol as hydrogen bond acceptor. In our study, we have chosen two model drugs: 1) ethosuximide a water-soluble anticonvulsant drug, and 2) dimethyl fumarate, which has low water solubility, used for the treatment of multiple sclerosis. Experimental data clearly indicate that molecular mobility in gel systems is not influenced by concentration changes and is always lower than the diffusion observed in aqueous solution.

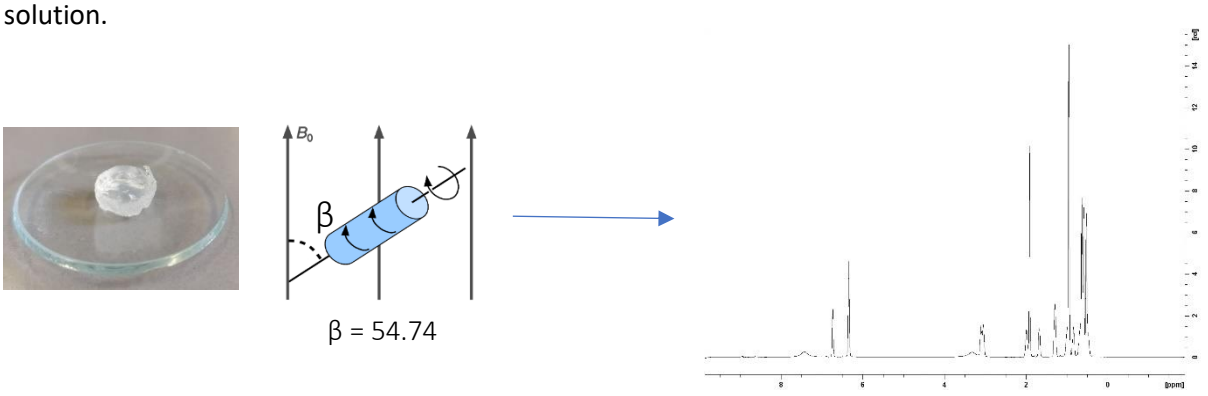

Figure 1: a) Menthol/Thymol 1:1 eutectogel b) schematic HR-MAS functioning concept c) 1H HR-MAS spectrum of menthol/thymol eutectogel.

References:

[1] S. Chakraborty, J. H. Chormale, A. K. Bansal. *Int. J. Pharm.* **610** (2021), 121203.

[2] C. Zeng, H. Zhao, Z. Wan, Q. Xiao, H. Xia, and S. Guo. *RSC Adv.***10** (2020), 28376-28382.